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Issued November 14, 1911.

U. S. DEPARTMENT OF AGRICULTURE.

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FARMERS' BULLETIN 473.

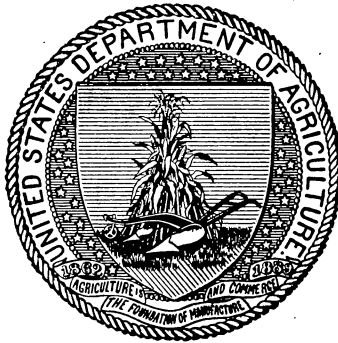
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# TUBERCULOSIS.

A PLAIN STATEMENT OF FACTS REGARDING THE  
DISEASE, PREPARED ESPECIALLY FOR FARMERS  
AND OTHERS INTERESTED IN LIVE STOCK,

BY THE

INTERNATIONAL COMMISSION OF THE AMERICAN VETERINARY MEDICAL  
ASSOCIATION ON THE CONTROL OF BOVINE TUBERCULOSIS.



WASHINGTON:  
GOVERNMENT PRINTING OFFICE.  
1911.

## LETTER OF TRANSMITTAL.

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF ANIMAL INDUSTRY,  
*Washington, D. C., September 27, 1911.*

SIR: I have the honor to transmit herewith the manuscript of a treatise on tuberculosis, prepared by an international commission of the American Veterinary Medical Association on the control of bovine tuberculosis. This paper has been written with the object of placing before farmers and stock raisers a simple and concise statement of the principal facts about this disease. Coming from a representative body of men who combine both scientific and practical knowledge, it may well be regarded as an authoritative presentation of the subject. I respectfully recommend that it be published in the Farmers' Bulletin series of this department.

Respectfully,

A. D. MELVIN,  
*Chief of Bureau.*

HON. JAMES WILSON,  
*Secretary of Agriculture.*

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# TUBERCULOSIS.

## A PLAIN STATEMENT OF FACTS REGARDING THE DISEASE.

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Tuberculosis is a widespread disease affecting animals and also man.

Human beings and cattle are its chief victims, but there is no kind of animal that will not take it. Hogs and chickens are quite often affected; horses, sheep, and goats but seldom, while cattle are the most susceptible of all animals.

### NATURE OF THE DISEASE.

Tuberculosis is contagious, or "catching." It spreads from cow to cow in a herd until most of them are affected. This may not attract much notice from the owner, as the disease is slow to develop and a cow may be affected with it for several months and sometimes years before any signs of ill health are to be seen.

This slow development is the chief reason for the great loss it causes to the farmer. He does not suspect its presence in his herd until perhaps a large number are diseased. If the disease developed rapidly and caused death in a few days, the owner would soon take steps to check its progress and protect the rest of his herd. Tuberculosis is slow and hidden in its course and thus arouses no suspicion until great damage is done.

### HISTORY.

Where did tuberculosis come from? We do not know. History records it from the earliest times.

Over a century ago its contagious nature was suspected and many facts were recorded to prove that it must be "catching." Doctors differed about it and for a long time the question was hotly disputed. Finally it was settled by Dr. Robert Koch, a distinguished German physician, who discovered the germ of the disease in the year 1882, and named it *Bacillus tuberculosis*. He proved by experiment that the disease is produced by these germs and without them the disease can not be produced. It is now universally admitted that tuberculosis is a contagious disease and may be transmitted from animal to man.

In America the disease was introduced with early importations of cattle and has been with us ever since. Modern methods of transportation by rail and water have spread the disease from one end of the continent to the other. No part of the country is entirely free from it, but it is more prevalent near the great centers of population than in the remoter parts.

### IMPORTANCE.

The importance of the disease must be estimated from two points of view, first, the loss it entails upon the cattle owner, and, second, the danger of communication to human beings.

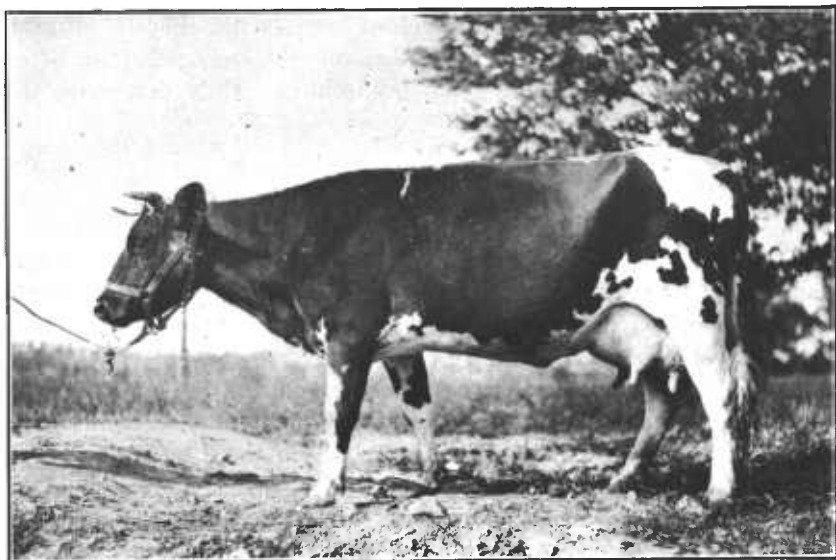


FIG. 1.—An apparently healthy cow affected with tuberculosis. She does not cough, her appetite is good, she seems strong and vigorous, and gives an unusually large quantity of milk. At the time the picture was taken it was known that she had been tuberculous at least four years and that she had been passing large numbers of tuberculosis germs from her body at least three years. Since it first became known that the cow was diseased she has given birth to four calves.

Consider first its effect upon the pocket of the owner of cattle, whether farmer, breeder, or dairyman. A serious percentage of the dairy cows of the continent are affected, and the disease is found in even a larger percentage of dairy herds. The disease is commoner in some regions than in others.

It is no uncommon thing to find as many as 70 or 80 per cent of the cows in a herd diseased. These animals will be in various stages of the disease, some recently infected showing no sign of ill health, others badly diseased, but outwardly appearing healthy, while a few are evidently breaking down and wasting away.

The loss to the owner is evident when a cow dies of the disease, or when an apparently healthy cow is slaughtered for beef and found so badly affected as to be unfit for food.

The calves in such a herd do not long remain healthy. They catch the disease before they are many months old and are a source of loss instead of gain.

Although the disease is most frequently found in herds that are more or less closely confined, such as dairy herds and purebred cattle, other herds are by no means free from it. Even range cattle are sometimes affected, and the infection spreads in spite of the open-air life of the cattle.

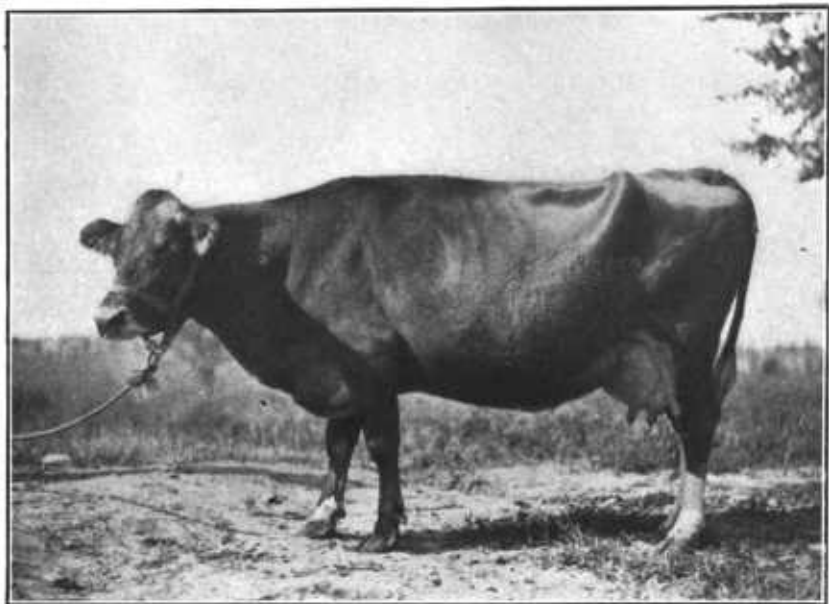


FIG. 2.—An apparently healthy cow affected with tuberculosis. She does not cough, her appetite is good, she gives a large quantity of milk, and is in excellent general condition for a dairy cow. At the time the picture was taken it was known that she had been affected with tuberculosis at least four years and that she had been passing tuberculosis germs from her body at least three years. The mixed dung of this cow and of the cow shown in figure 3 caused tuberculosis in hogs that were permitted to eat it.

Tuberculosis is common among hogs. The public abattoirs report that a serious percentage of all hogs inspected is found to be tuberculous.

The aggregate of these losses among cattle and hogs is enormous, amounting to millions of dollars every year, besides materially decreasing the food supply of the country.

Turning to the other aspect of the case, the danger of infection of human beings with tuberculosis from cattle, we have only to consider a few facts to realize its vital importance to every community.



Milk is the staple food of infants and young children and is usually taken in the raw state. If this milk is from a tuberculous cow, it may contain millions of living tubercle germs. Young children fed on such milk often contract the disease, and it is a frequent cause of death among them.

Meat from tuberculous cattle is not so likely to convey the infection, for several reasons. It does not so frequently contain the germs, cooking destroys those that may be present, and, lastly, meat is not consumed by very young children.

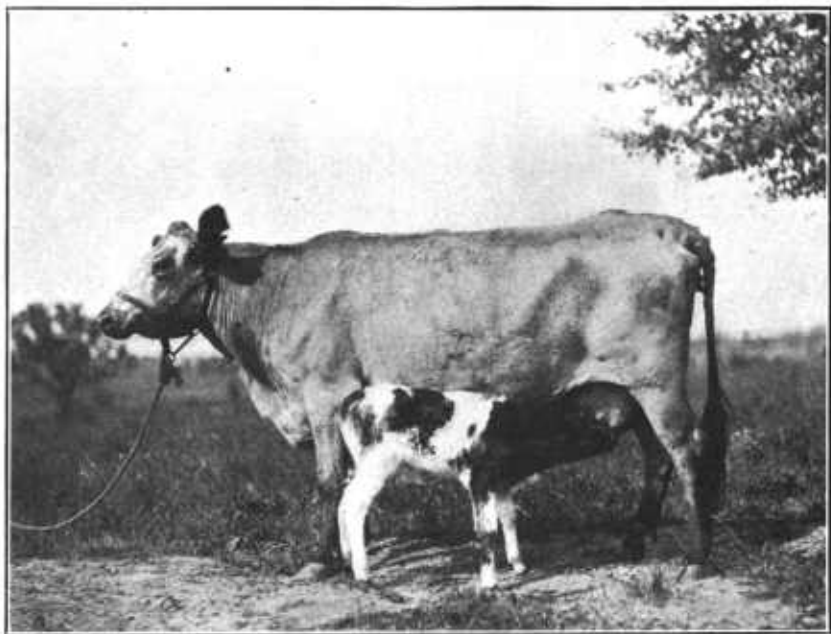


FIG. 3.—An apparently healthy cow affected with tuberculosis. She does not cough, her appetite is good, and her general condition is excellent for a milch cow that has recently calved. At the time the picture was taken it was known that she had been affected with tuberculosis at least four and one-half years and that she had been passing tuberculosis germs from her body for a long time. The calf by her side is the fourth she has produced in the last four years. Small quantities of her dung caused tuberculosis in guinea pigs when it was placed under their skin. The mixed dung of this cow and of the one shown in figure 2 caused tuberculosis in hogs that were permitted to eat it.

### SYMPTOMS.

Before describing the symptoms or signs by which tuberculosis is recognized or suspected in a living animal it is well to state that there is no symptom that can be relied on with certainty. Any of the symptoms may sometimes be caused by some other disease, and not one of them is characteristic of tuberculosis alone.

Many of the symptoms that are relied on by the human physician in reaching his opinion are not available in examining cattle. The

thickness of the skin and chest wall, for instance, makes it difficult to detect a diseased condition of their lungs by listening to the sounds made in breathing, whereas this is comparatively easy in human beings.

It must also be clearly remembered that cattle may be very badly diseased and yet show no symptoms of ill health. They may be fat and sleek, looking the picture of health, while their lungs and other organs are full of tubercles. Such cases can only be detected by the tuberculin test.

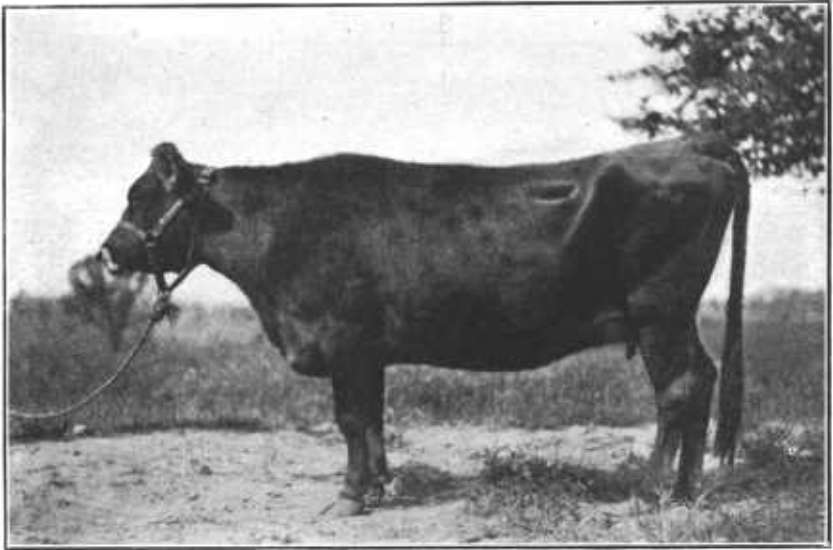


FIG. 4.—An apparently healthy cow affected with tuberculosis. This cow is in excellent condition for an animal that has been affected with tuberculosis more than four years. Three years before the picture was taken tuberculosis germs were found in her dung, and hogs that were permitted to eat it became tuberculous. About two and one-half years before the picture was taken it was found that her milk contained tuberculosis germs. There was nothing visible about the udder to show that it was diseased, and it was only after two months of the most careful tests of her milk that an expert could tell from which of the four quarters of the udder the disease germs were being passed.

As tuberculosis may attack almost any organ of the body, we may have in each case the symptoms connected with the part affected as well as those affecting the general state of the body as a whole. We will take up in detail each of the more important symptoms suggestive of the disease:

**Unthriftiness.**—The animal is not doing as well as it should for the care and feed it is getting. Its coat is rough and its skin has lost its suppleness and feels harsh and thick.

**Loss of flesh.**—Along with the unthriftiness is noticed a gradual loss of flesh; the animal gets thinner from week to week. It appears to be pining away, and such cows have been known to dairymen

for a long time under the name of "piners" or "wasters." After a time they are reduced almost to skin and bone.

**Cough.**—This symptom is only present when the disease is attacking the lungs or some part of the breathing organs. It is not a loud, sonorous cough, but rather a subdued and infrequent one, and may be heard only at such times as when the stable is first opened in the morning or when the animal is driven. At a later stage of the disease it may be heard at any time of the day. Cows do not usually appear to cough up anything. This is because they do not spit. Most of the material coughed up from the lungs is swallowed, but many

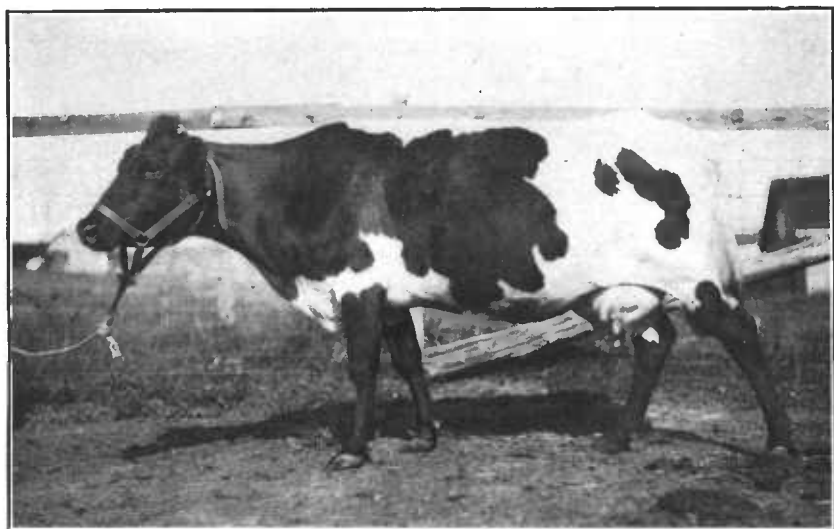


FIG. 5.—A cow affected with long-standing, advanced tuberculosis, with large tuberculous swellings in the udder. A year before the picture was taken the cow was discovered to have udder tuberculosis. This discovery was made by injecting some of her milk into guinea pigs; there was nothing in the appearance or external condition of the udder at first to show that it was diseased. How very dangerous such cows are may be judged from the fact that calves that are permitted to drink milk from tuberculous udders only a single time are almost certain to have tuberculosis. A small amount of milk from cows like those in the above picture and in figure 4 mixed with the milk of other cows will make the whole of it dangerous for both persons and lower animals.

tuberculosis germs escape from the mouth in the form of spray or are discharged from the nose.

**Enlarged glands.**—Enlargements in the region of the throat, especially when they cause difficulty in breathing, are very apt to be due to tuberculosis.

**Loss of appetite.**—This symptom is not seen until the later stages of the disease, when the animal is evidently wasting.

**Bloating.**—Sometimes the diseased glands in the chest prevent the usual passage of gas from the paunch to the mouth by pressing on the gullet. In this case the cow suffers from bloating, and the paunch

is often greatly distended with gas. This, however, is not a very frequent symptom.

**Diarrhea.**—Looseness of the bowels or “scouring” is seen in cattle affected with the disease in the bowels. This kind of scouring can not be cured by any known treatment.

**Hard lumps in the udder.**—When tuberculosis attacks the udder no change can be detected at first, but after a time hard lumps can be felt in some parts of the organ after it is milked out. Milk from such an udder must not be used, as it is almost certain to be teeming with germs of the disease.

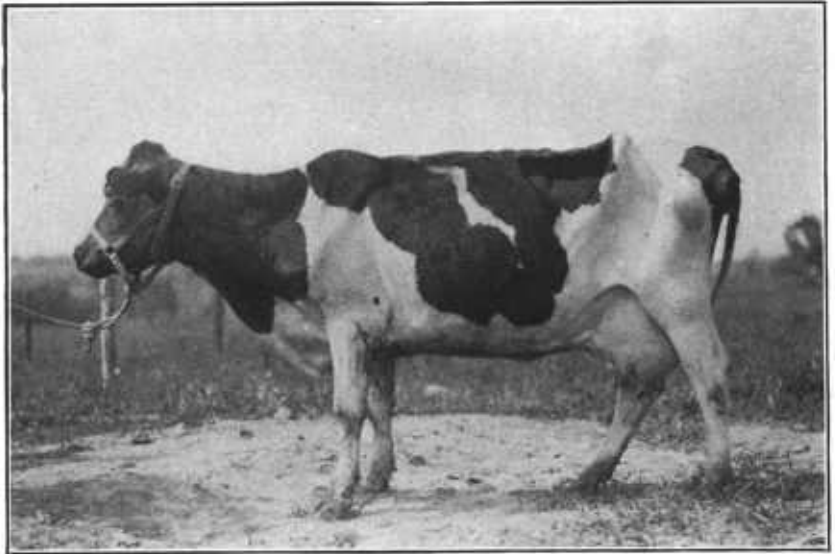


FIG. 6.—A cow in an advanced stage of tuberculosis. She is very weak and thin, hut is a heavy milker and in her weak condition continues to give an abundant quantity of milk. Cows of this kind are unfortunately too numerous in dairy herds. The temptation to keep such cows and to use their milk is greater than some persons can resist. Such cows are a great danger to other animals that may come in contact with them, and the use of their milk in a raw state is very apt to cause tuberculosis alike in young persons and lower animals.

### POST-MORTEM APPEARANCES.

When the carcass of a cow affected with tuberculosis is opened the disease may be found in any part of the body. Lumps (tubercles) may be present in the substance of an organ such as the lung or liver, or they may be growing on the surface. These lumps may be so small as to be scarcely noticeable, or they may be as large as the closed fist, or even larger. If one of the lumps is cut open, the inside is yellowish and grits on the knife like sand, or else is of a cheesy nature, soft and creamy, or hard and dry.

The lung is a favorite place for tubercles, and should always be examined. Lymph glands are often the seat of tuberculous changes. When healthy a lymph gland is a little rounded body not much larger than a good-sized bean, the largest only the size of one's thumb. They are found all through the body, and when healthy are so small as to attract very little attention. Tuberculosis may cause them to grow to an enormous size, sometimes as large as a child's head. In this condition they are similar to the tuberculous lumps already described. Those lying between the lungs and in the throat are the most frequently affected.

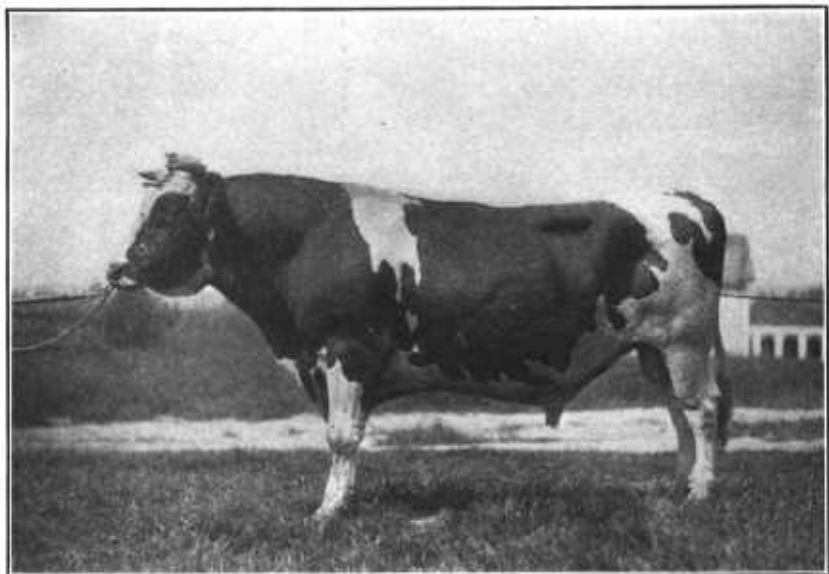


FIG. 7.—A tuberculous bull in apparently healthy condition. The picture was taken nearly four years after he was first known to be tuberculous and three years after it was known that he was passing tuberculous germs from his body. Directly after his picture was taken he was killed, and in addition to numerous nodules of tuberculosis in his lungs it was found, when his body was opened, that nearly all the lymph glands connected with his bowels and liver were diseased. At the time of his death the bull weighed 1,850 pounds, and his apparent condition was excellent for an animal that was fed only rough forage and no grain in any form. The presence of tuberculosis in his body would never have been suspected before his death without the help of the tuberculin test.

Tubercles may be found in any part of the body—glands, lungs, liver, bowels, kidneys, womb, udder, and even bones. The muscles and skin are seldom affected.

### THE TUBERCLE BACILLUS.

The germ of the disease, the tubercle bacillus, is a tiny, slender, rod-shaped body. Several thousands of them placed end to end

would be needed to measure an inch, so that they are quite invisible to the naked eye. A powerful microscope is needed to see them.

Once the bacillus has gained lodgment inside the body of an animal, it begins to grow and multiply. It gets longer, and when full grown divides crosswise, making two out of one. Each of these goes through the same process, the two become four, the four eight, the eight sixteen, and so on indefinitely.



FIG. 8.—Sections of a tuberculous udder from a cow. Practically the whole of the udder was changed into tuberculous material. Long before tuberculous udders become as badly diseased as the condition shown in the picture the milk contains large numbers of tuberculosis germs and is very dangerous. A tuberculous udder may contain only a single small tuberculous swelling through which the milk becomes dangerously infected with tuberculosis germs.

This multiplication takes place quite rapidly when conditions are favorable, a few hours only being required for the birth of each generation. Nature, however, does not permit this process to continue long without offering some resistance. The forces of the body are roused to action and a battle begins between the tissues of the body and the army of the invaders.

The first line of defense is composed of the white cells of the blood, which hurry to the scene of action and endeavor to destroy the invaders by eating them up.. Sometimes they are successful and the bacilli are destroyed, the infection checked. Often they fail in their object and are themselves destroyed and the multiplication of the germs continues.

The second line of defense is formed by the cells of the tissue invaded by the germs. These cells arrange themselves in a circle around the germs and try to form a living wall between them and the rest of the body. This barrier gradually becomes thicker and



FIG. 9.—Sections of a tuberculous liver from a cow. The light-colored parts show the disease.

thicker and forms a little hard lump or tubercle, from which the disease gets its name. If this wall is complete and successfully imprisons the bacilli, these gradually die and the disease in that particular spot is arrested.

Frequently, however, both these safeguards are overcome. The germs break through the barriers and are carried in the blood stream or lymph channels to other parts of the body. New points of attack are selected and the process begins again but with less chance on the side of the animal. As the tubercles increase in number the power of the body to grapple with them becomes less and less, and gradually the animal falls a prey to the disease.

The tubercle bacillus does not multiply outside the body of an animal. It can live for a long time in favorable surroundings, such as dark and dirty stables. Sunlight soon destroys it. Freezing does not hurt it, but it can only stand a moderate amount of heat. Exposure of 149° F. for 20 minutes kills it. Protected by a layer of dried mucus, such as is coughed up from the lungs, it withstands drying, light, and ordinary disinfectants, but is readily killed by steam or boiling water.

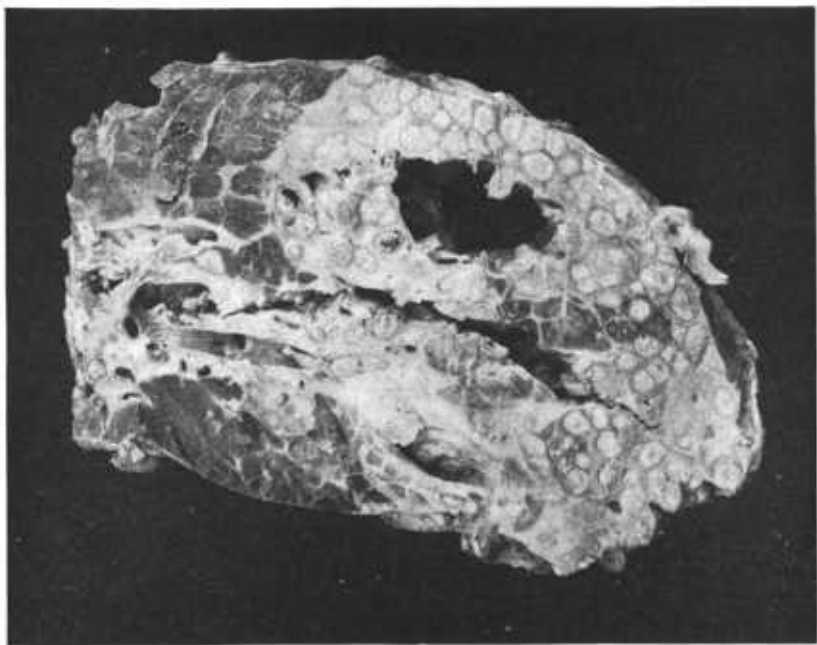


FIG. 10.—Section of a tuberculous lung from a cow. The picture shows numerous nearly round tuberculous nodules, one large tuberculous cavity, and several air tubes that extend from tuberculous nodules that are softening and breaking down. When tuberculous nodules in the lungs break down the material of which they are composed, and which contains millions of tuberculosis germs, is coughed up. Some of the germs are sprayed from the mouth and others are swallowed and discharged with the dung.

### HOW THE DISEASE SPREADS.

Sooner or later the tuberculous cow begins to give off the germs of the disease. The germs escape by the mouth and nose, the bowels, in the milk, and in discharges from the genital organs. When the germs are being given off in any of these ways, the disease is known as *open tuberculosis*.

Germs discharged from the mouth and nose are coughed up from the lungs and are sprayed over the food in front of the cow or are carried in the air for a time until they fall to the ground. Cows in



adjoining stalls may take in these germs in the air they breathe or in the food they eat and so contract the disease.

Germs discharged from the bowels are mixed with the manure, and may infect cattle and hogs that are allowed to pick over the dung heap. The practice of having hogs and cattle together in the same yard is sure to result in the infection of the hogs if any of the cattle are affected. The germs in the manure come from matter that is coughed up and swallowed, and in some cases from tuberculosis in

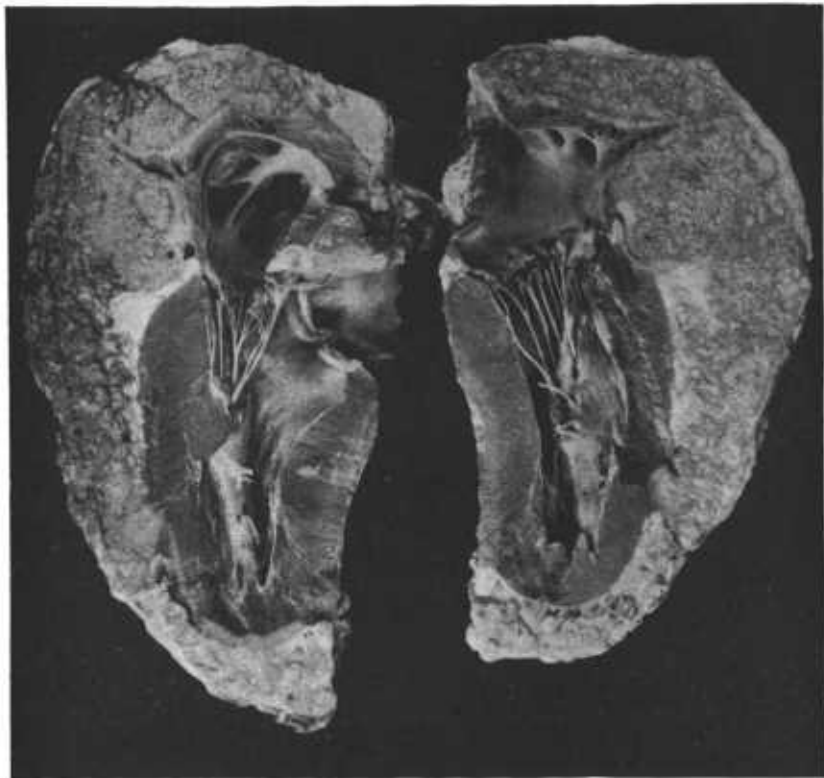


FIG. 11.—Sections of a tuberculous heart from a cow. The light parts are tuberculous. The heart muscle is greatly reduced in volume and is prevented from working properly by the tuberculous material by which it is surrounded. The picture shows how badly an animal may become diseased with tuberculosis before it dies. One reason why tuberculosis is so common among persons and cattle is that many persons and cattle pass tuberculosis germs from their bodies before anyone knows or suspects that they have tuberculosis and can give the disease to others.

the bowels themselves. Manure containing tubercle germs may easily infect the milk. Particles of dried manure may fall into the milk pail from the skin of a dirty cow or be accidentally flicked off from the tail and fall into the milk. Straining the milk afterwards only removes the larger particles. The smaller ones, including the germs, remain in the milk.

When the udder is tuberculous the milk contains the germs in vast numbers. Such milk may look and taste perfectly good, but readily transmits the disease to young animals. It is very dangerous to children. Hogs and calves are very readily infected by it.

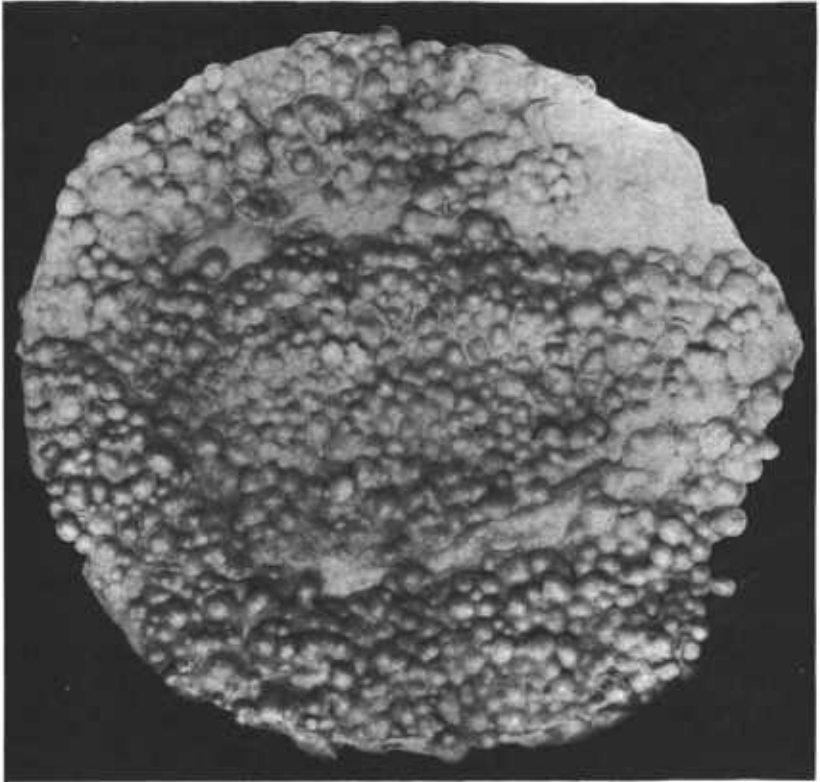


FIG. 12.—Tuberculosis of the omentum or caul, or the net covering the bowels. This form of tuberculosis is known as "pearl disease," because the tuberculous tumors look like pearls.

### HOW A HERD IS INFECTED.

Tuberculosis may be introduced into a healthy herd in a number of ways:

1. By the purchase of a bull or other animal that is infected with the disease. This animal may be apparently healthy at the time of purchase, but if it contains the germs, the disease may develop and spread to other cattle. New animals should only be bought from a herd that is known to be healthy.

2. By feeding calves with milk, buttermilk, or whey that has come from tuberculous cows. A farmer may have a healthy herd, but if he brings home skim milk from a creamery and feeds it to his calves

he may give them the disease. Such milk should be rendered safe by boiling or pasteurizing it.

3. By showing cattle at fairs and exhibitions where no proper care is taken to keep out diseased stock or to disinfect the stables.

4. By shipping animals in cars that have not been disinfected, as these may have recently carried diseased cattle.

5. By allowing cattle to graze with diseased ones, or to come in contact with them over fences.

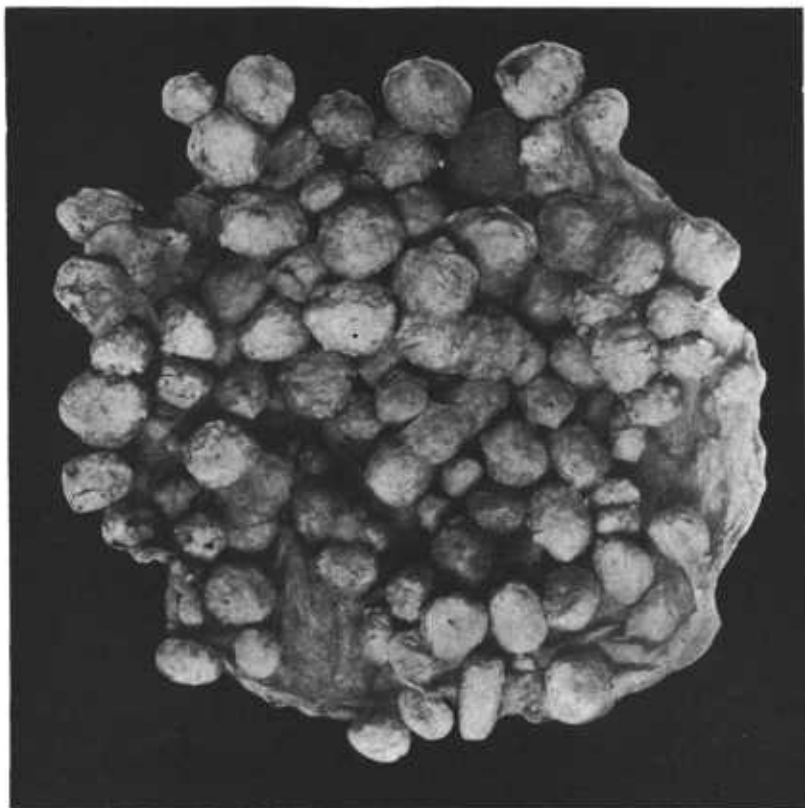


FIG. 13.—Tuberculosis of the omentum or caul. The picture shows another form of "pearl disease," in which each nodule is about the size of a grape and is composed of a large number of smaller nodules which have grown together.

### THE TUBERCULIN TEST.

Tuberculosis develops so slowly that in many cases it is months and sometimes years before any symptoms are shown. During this period the infected animals can not be distinguished from the healthy in any ordinary way. There is a test, however, which does no harm to the healthy yet detects the diseased practically without fail. This

is known as the tuberculin test, because the substance used in making it is called tuberculin.

#### WHAT IS TUBERCULIN?

Tuberculin is a fluid containing the products of the tubercle germ without the germs themselves. As it contains no living germs, it can not convey the disease. Great skill is required in its preparation. A special fluid (or culture medium) is prepared and the tubercle bacilli planted in it, great care being taken to keep all other germs out. The fluid is then placed in a special kind of incubator and kept at the temperature of the animal body. Under these conditions the germs grow and multiply. Gradually the fluid becomes filled with the products of the germs. When the right point is reached the fluid is heated sufficiently to kill the germs, which are then strained out. The remaining fluid is tuberculin.

Tuberculin does not harm healthy cattle, even in large doses, but on diseased animals it produces a marked effect. This is shown by a feverish attack which comes on about 8 to 12 hours after the tuberculin is administered, lasts a few hours, and then subsides. This temporary fever is called the reaction, and animals which show it are called reactors. The value of the test lies in the fact that diseased animals react, while healthy ones do not.

#### RELIABILITY OF THE TEST.

The tuberculin test in the hands of a competent and experienced man is much more accurate than any other method of detecting tuberculosis. The records of large numbers of tests made by Government officials show that with certain precautions it is accurate in 98 per cent of the reactions obtained. This gives a margin of a possible 2 per cent of error, and this small number may be still further lessened by care in making the test. For practical purposes any animal that reacts must be considered tuberculous.

#### LIMITATIONS OF THE TEST.

The test should not be applied to cows that have just calved or are about to calve, as the temperature at this time is apt to vary considerably from the normal. For this same reason it should not be applied to any animal that is in a feverish condition from any cause.

The test fails to detect the presence of the disease in the animal that is very recently infected. The disease has to make a little progress before the test reveals its presence, and in the beginning of each case there is a period between the entrance of the germs into the body and the time when they have multiplied sufficiently for the test to reveal their presence. This is called the period of incubation and lasts from ten days to two months.

When the disease is far advanced and the animal is wasting, the test sometimes fails to detect it. This is not of much practical importance, as such cases can generally be recognized without the aid of tuberculin.

### PROTECTIVE INOCULATION.

For some years efforts have been made to discover a method of rendering cattle immune to the disease in such a way as men are protected from smallpox by vaccination. Up to the present these efforts have been only partially successful, and until the methods in use have been perfected by further investigations they can not be recommended as of practical use in the suppression of the disease.

### SUPPRESSION OF THE DISEASE.

The first step in getting rid of the disease is to find out how many of the herd are affected by it. This is done by applying the tuberculin test. This will show a larger or smaller number of the herd to be affected, and the proper course to pursue will depend largely upon the proportion of the reactors in it.

Suppose that only a few cattle react, say 15 out of 100, or in that proportion. In this case the reactors are first carefully examined, and if any of them show symptoms of the disease by coughing, loss of condition, or any other of the signs by which the disease is recognized without the test, such animals should be slaughtered.

The other reactors should then be entirely separated from the healthy cattle. If possible they should be put in a separate building, but if this can not be done a tight partition should be built between the diseased and the healthy cattle and separate ventilation provided. The person who attends to the reactors should not go near the healthy animals, as he may carry the infection to them on his hands, clothes, or boots. For the same reason the feeding and watering must be done with separate utensils.

When at pasture the reactors must not be put into a field where they can reach across a fence to healthy cattle. Whenever a calf is born among the reactors it should be immediately separated from its mother and brought up by hand or on a healthy cow. The calf is usually born healthy, but would soon catch the disease from its mother if allowed to remain with her.

The milk of reacting cows may be used if it is first boiled or heated to a point sufficient to kill the germs. This heating to a point less than boiling is called *pasteurizing*, and is safe provided all the milk reaches the required degree of heat and is kept there sufficiently long.

For this it is necessary to keep the milk for 20 minutes at 149° F. or for 5 minutes at 176° F.

This system of dealing with tuberculosis in a herd was planned by Prof. Bang, of Denmark, and has been very successfully followed in that country for some years. It has the advantage of allowing the reactors to be made use of while a sound herd is being built up. Under this system the sound herd increases in numbers as healthy calves are added to it, while the diseased herd becomes smaller as the reactors die off or are killed as open cases of tuberculosis. Finally a point is reached where only a very few reactors remain, and the owner will then find it to his interest to kill them rather than have the trouble of keeping them isolated.

Some time is required for the successful carrying out of the Bang system, and the owner must be prepared to follow it steadily and faithfully for the whole time that is needed, which may be several years. During this time the healthy herd must be tested every six months and any reactors removed to the diseased herd. At the same time a sharp lookout must be kept for animals showing definite symptoms of the disease. These should be destroyed promptly, as they are the most dangerous source of infection.

**Dealing with a badly infected herd.**—Where the test shows more than half the number diseased, a somewhat different plan is required than the Bang system. This herd is so badly affected that the non-reactors can not safely be considered healthy. Many of them are sure to have been infected with the disease quite recently, so that the test fails to detect it. These will react at the next test, and in the meantime may develop the disease so rapidly as to infect others. This will repeat the difficulty occurring at the first test, and it would be a long and tedious process of weeding before even a small but perfectly healthy herd could be established.

For these reasons it is better to treat such a herd as if it were entirely diseased and to begin with the newborn calves to build up a healthy herd. The method from this point is exactly the same as the Bang system, except that as there are no healthy cows to act as foster mothers the calves must be raised on pasteurized milk. At 6 months old the calves are tested and reactors are transferred to the other herd. This plan was devised by a German veterinary surgeon named Ostertag, and is known as the Ostertag system. It is very successful when carefully carried out.

While getting rid of the disease by whatever system may be adopted, an animal should never be bought for the healthy herd unless known to be healthy. The tuberculin test should be applied, and if possible the animal should be selected from a herd that is

known to be free from tuberculosis. New purchases should be isolated or kept apart from the healthy herd, and if possible from each other for at least three months, when they should be retested to make sure they are healthy before putting them with other cattle.

### SANITATION.

Dark, dirty, crowded stables are favorable to tuberculosis. Under these conditions the disease spreads rapidly and is only kept out with difficulty.

Clean, airy, well-lighted stables, on the other hand, are unfavorable to the development of the disease. If brought into such a stable it does not spread so rapidly and is not so difficult to get rid of as in the first case.

A well-built, sanitary stable need not be made of expensive material or of elaborate design, but should have plenty of light, air, and drainage.

Light is very important. Direct sunlight is a great destroyer of germ life. Tubercle bacilli soon die if exposed to sunlight. It is a disinfectant, always ready to work without cost. Sunlight is also necessary to the health of animals. Men deprived of it for any length of time, as prisoners in jail, become pale and lose the appearance of health. Cattle that are constantly confined in dark stables become lowered in vitality and are ready to catch any disease with which they come in contact. For these reasons the cow stables should have plenty of windows, on two or more sides, if possible, so that the sunlight can reach every part of the interior some part of the day.

Pure air is also very important. In badly ventilated stables the air is breathed over and over again until it becomes more or less poisonous. Animals kept in such conditions become gradually reduced in vitality. This change may not be noticeable to the observer, but becomes apparent if the animal is exposed to disease. It easily contracts disease and does not recover from it readily.

Stables should therefore have plenty of air space for each animal. This requires the ceiling to be high, the stalls roomy, and the passages wide. In addition to this ample air space some way of changing the air in a stable must be provided. This is done by means of suitable openings in the walls and roof and comprises the system of ventilation.

**Ventilation** to be successful must provide for two things—first, the removal of the foul air from the inside, and, second, the bringing in of fresh air from outside the building. No system is good that fails to accomplish these objects without causing unnecessary drafts.

The usual way is to bring in fresh air through open windows, and in cold weather through ventilating shafts, which may be concealed

in the walls or beneath the floor. The foul air is removed by open windows and by ventilating shafts from the ceiling to the roof, where they are usually protected by a hood. When both inlets and outlets are proportioned to the size of the building there should be a constant circulation of air and no sensation of closeness should be perceptible in the stable.

**Drainage** removes the liquid refuse from the stable by suitable gutters and drains. It can not do this unless the floor is water-tight, and concrete flooring is therefore recommended. Urine leaking through cracks in the floor until the soil beneath is saturated is a frequent source of foul odors and unhealthy stables.

**Cleanliness.**—Since the manure of tuberculous cattle often contains living tubercle germs in vast numbers, the importance of keeping it well cleaned out of the stable is readily seen. Such manure is not only dangerous to other cattle in the stable, but may be the means of conveying the disease to children. Often cows are seen with their flanks incrustated with dry dung. Parts often break off while the cow is milked, and some of it is likely to fall into the milk pail. The larger lumps are strained out, but the smaller particles remain, and also the tubercle germs, which are small enough to pass through any strainer. These stay in the milk and make it a fruitful cause of the disease in the young.

Stables should be cleaned out often and the manure put where it can not be picked over by hogs or cattle. These animals are easily infected in that way. Cleanliness also includes keeping the walls and ceilings free from dirt, dust, and cobwebs. These are all good resting places for disease germs.

Whitewashing the interior of the stable at least twice a year is a great aid to cleanliness, and also has a distinct effect in destroying disease germs. In many municipalities dairy stables are required to be whitewashed at regular intervals, and it is a practice that should be universal.

[A list giving the titles of all Farmers' Bulletins available for distribution will be sent free upon application to a Member of Congress or the Secretary of Agriculture.]